FIDELIS GODFREY MAMBA 18/ENG04/040
ELECT/ELECT.
ENG 214.

1. Ideal flow rate = normal displacement × speed
= 10 × 1500 = 15 dm³/min

i. Volumetric efficiency = $\frac{\text{Actual flow}}{\text{Idea flow}}$ = $\frac{10}{15}$ = 0.67 = 67 %

ii. Fluid power = ΔPQ.
ΔP = 12 × 10⁵ = 1,200000
Q = $\frac{10 \times 10^{-3}}{60}$ = 1.67×10^{-4}
ΔPQ = 200.7 watts

iii. Shaft power = $\frac{2\pi NT}{60}$ = 2 × π × 1500 × 12.5 = 1964.3 Nm

iv. Overall efficiency = $\frac{\text{fluid power}}{\text{shaft power}}$ = $\frac{200.4}{1964.3}$ = 0.102 = 10.2 %

2. 87 % = f.p/sp
Fluid power = ΔPQ
P = 100×10^5 N/m²
Q = 35×10^{-3} = 5.83×10^{-4} = 5833.3 watts

87 % = $\frac{5833.3}{x}$ = $x = \frac{5833.3}{0.87}$ = 6705 Nm

3. Idea flow rate = normal displacement × speed
= 50 × 850 = 42.5 dm³/min

Volumetric efficiency = $\frac{\text{Actual flow}}{\text{idea flow}}$ = $\frac{35}{42.5}$ = 0.82 = 82 %

Fluid power = ΔPQ.
ΔP = 100×10^5 , Q = $\frac{50 \times 10^{-3}}{60}$
ΔPQ = 8300

shaft = 15 Kwatts = 15000

Overall efficiency = $\frac{8300}{15000}$ = 0.553 = 55.3%.

4. z = 24,000 cm = $\frac{24000}{100}$ = 240 m.

flow rate = 13 l/s

$\frac{13}{1000} \times 1$ = 0.013 m^3/s

velocity of jet = 66 m/s.

Jet issuing from nozzle

P = 0, z = 0.

Density = 1000 kg/m^3.

$P = (P + \rho g z + \frac{\rho v^2}{2}) Q$.

$P = \frac{\rho Q v^2}{2} = \frac{1000 \times 0.013 \times 66^2}{2}$

P = 28314 W = 28.314 Kw.

ii at P = 0, v = 0.

$\rho Q g z$ = 1000 × 0.013 × 9.8 × 240 = 30576 w = 30.576 kw.

iii. Power loss = 30.576 − 28.314 = 2.262 kw = 2262 w.

$h = \frac{\text{Power loss}}{\rho g Q} = \frac{2262}{1000 \times 9.81 \times 0.013}$ = 17.73 m.

iv. Efficiency = $\frac{\text{Power of jet}}{\text{power of reservoir}} \times 100 = \frac{28314}{30576} \times 100$ = 92.6%

5. S_g = 0.89

z = 30,000 cm = 30 m.

Q = 220 l/s = 0.22 m^3/s.

velocity of jet = 7 m/s

i. Specific gravity = $\frac{\text{Specific weight of liquid}}{\text{Specific weight of water}}$

ρ = 890 kg/m^3.

Specific weight of liquid = 8730.9 N/m^3.

$P = \frac{\rho v^2 Q}{2} = \frac{57 \times 7^2 \times 0.22}{2} = 4777.1 w = 4.7771 Kw$

ii. $P(PQ + \rho_2 g Q + \frac{\rho v^2 Q}{2})$

$\rho_2 g Q = 870 \times 300 \times 9.81 \times 0.22 = 576237.4 w = 576.2374 Kw$

iii Power loss $= 576237.4 - 4777.1 = 5714423 w$

Head used $= \frac{571442.3}{870 \times 9.81 \times 0.22} = 297.50m$

iv. efficiency $= \frac{4777.1}{576237.4} \times 100 = 0.83\%$

6. $h = 20m$

$d = 10cm = 0.1m$

$A = \frac{\pi d^2}{4} = 0.7854$

$w = ?$

$v^2 f = v_1^2 - 2gh$

$v_1 = \sqrt{v_1^2 + 2gh}$

$v_1 = \sqrt{0^2 + 2(9.8m/s)^2(20)} = 19.80m/s$

$Q = VA = (19.80)(7.854 \times 10^{-3} m^2) = 0.155 m^3/s$

$w = \rho g Q h$

$(1000 \times 9.8 \times 0.155 \times 20) = 30478 kgm^2/s^3 = 30 \times 10^3 w$

7. $P_1 g = 19.62 N/m^2$

$Cd = 0.96$

$d_1 = 0.3m$

$d_2 = 0.2m$

$Q_1 = 4\ 0.0707$

$u_2 = Q_1\ 0.0314$

$P - P_2 = 19.62 (z_2 - z_1) + 567.428 - 0$ —— Q_1

$P_1 - P_2 = 19.62 (z_2 - z_1) + 0.803 u_2^2$ —— Q_2